SEGMENTED PYRAMID ROLLER

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Serial No. 60/418,414, filed on October 15, 2002, and herein incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] This invention relates in general to a segmented pyramid roller, and deals more particularly with a segmented pyramid roller which is capable of selectively providing a curved profile, of an adjustable and predetermined radius, to a metal workpiece while maintaining the structural integrity of seams, bends or folds formed thereon.

BACKGROUND OF THE INVENTION

[0003] It is oftentimes desirable that metal workpieces, such as elongated strips of duct or the like, be formed to include a curved section. Roll bending machines are typically employed for this purpose and are commonly manually driven.

[0004] One of the problems sheet metal workers encounter when rolling curved sections of a workpiece having seams or formed edges formed thereon is that the standard pyramid roll bending machines employ rollers which cannot accommodate all the possible seams or forms of the workpiece during the rolling process. As shown in Figure 1, a standard pyramid roll machine **10** has three forming rollers that work together to provide a radius to a metal workpiece. Two opposed rollers, an upper roller **12** and an unillustrated lower roller, are set to grip the workpiece and drive it through the roll machine **10**. The third roll **14** is the radius form roller. It is adjustable and acts to provide a predetermined radius to the workpiece. These three rollers may also be equipped with a clearance channel **16** cut into, for example, the third roller **14** to accommodate those workpieces having bends or folds. Because this clearance channel **16** is cut

into the third roller **14**, it is fixed in position and does not provide clearance for seams or bends of various widths, or for workpieces with formed edges.

[0005] Moreover, when the workpiece has multiple thicknesses, due to multiple folds or seams along the edges, the rollers of the roll machine **10** must be set to a single dimensional clearance. This may cause the folds or seams to collapse or flatten when rolled. This damages the seam and can make the workpiece unusable.

[0006] With the forgoing problems and concerns in mind, it is the general object of the present invention to provide a segmented pyramid roll machine which overcomes the above-described drawbacks.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a segmented pyramid roller.

[0008] It is another object of the present invention to provide a segmented pyramid roller which is capable of selectively providing a curved profile, of an adjustable and predetermined radius, to a metal workpiece while maintaining the structural integrity of seams, bends or folds formed thereon.

[0009] It is another object of the present invention to provide a segmented pyramid roller which is capable of selectively accommodating a workpiece having seams, bends or folds of differing thicknesses.

[0010] These and other objectives of the present invention, and their preferred embodiments, shall become clear by consideration of the specification, claims and drawings taken as a whole.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Figure 1 illustrates a known pyramid roll forming machine.

[0012] Figure 2 illustrates a segmented pyramid roller, according to one embodiment of the present invention.

[0013] Figure 3 is a magnified view of the rollers of the segmented pyramid roller shown in Figure 2.

[0014] Figure 4 is a partial cross-sectional side view of the segmented pyramid roller shown in Figure 2.

[0015] Figure 5 illustrates a partially exploded view of the upper and lower rods and rollers of the pyramid roller shown in Figure 2

[0016] Figure 6 illustrates a partially exploded view of the radius rod and rollers of the pyramid roller shown in Figure 2.

[0017] Figure 7 is a partial cross-sectional side view of a segmented pyramid roller according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] Figure 2 illustrates a segmented pyramid roller **100**, according to one embodiment of the present invention. The segmented pyramid roller **100** includes three full length, one piece guide rods **102**, each having a plurality of movable, outer form rollers **104**. The one piece, solid rods **102** give the roller **100** the strength to prevent unintended deflection of a workpiece **106** during rolling of the workpiece **106**. A guide key **108**, shown in Figure 3, runs along the length of each of the rods **102** and is used to integrally mate with, and provide driven force to, a plurality of tubular shaped rollers **104** which are mounted about the outside diameter of the rods **102**. Each of the rollers **104** include a matching key groove **109** for accommodating the guide key **108** therein. Taken together, the rods **102**, the guide key **108** and the rollers **104** comprise the forming segmented rollers of the pyramid roller **100**.

[0019] The rollers **104** are the forming rollers and are each selectively movable along the length, or longitudinal axis, of the rods **102**. The rollers **104** are also

movable with respect to one another in order to define differing clearances between separate pairs of the rollers **104**, as will be described in more detail later.

[0020] As also shown in Figure 2, the pyramid roller **100** may be actuated via a handle assembly **105** which is operatively connected to one or more of the rods **102**, the force of which being transferred to the non-connected rods **102** via a suitable gear train or the like. Alternatively, the handle assembly **105** may instead be operatively connected directly to a gear train with the motive generated force being transferred to each of the rods **102** in a manner known to one of ordinary skill in the art. Moreover, the present invention equally contemplates that the drive force of the pyramid roller **100** may be any known motor or the like, without departing from the broader aspects of the present invention.

[0021] As shown in Figure 4, the rods **102** include a lower segmented pinch rod **110** which may be selectively adjusted to capture, or grip, the workpiece **106** between the lower segmented pinch rod **110** and an upper segmented pinch rod **112** via operation of a threaded adjustment assembly **114**. Similarly, a radius segmented pinch rod **116** of the roller **100** is likewise displaceable via another threaded adjustment assembly **117** and provides a variable radius of curvature to the workpiece **106**.

[0022] That is, as best seen in Figure 4, as the radius rod **116** is manipulated via the threaded adjustment assembly **117**, the radius rod **116** is displaced so as to impart a greater or lesser radius of curvature to the workpiece **106** as the workpiece travels through the roller **100**.

[0023] The opposed set of pinch rods, **110** and **112** respectively, can be set to grip the workpiece **106** for drive, while the rollers **104** may each be individually positioned along the rods **102**, thereby providing clearance at any place along the length of the rods **102**, to accommodate any seams or folds **107** of the workpiece captured therebetween, thereby preventing any deformation of the

seams or folds as the workpiece **106** is rolled. That is, the rollers **104** are capable of being positioned so that they may grip the single thickness of the material in places where there are no seams or folds **107**, while still accommodating seams or folds in the workpiece **106** which may themselves have differing thicknesses. In operation, the seams or folds **107** pass through the enhanced-clearance areas between the rollers **104** during the rolling process.

[0024] It is therefore an important aspect of the present invention that the present invention permits the selective accommodation of any seams or folds that may be present in the, typically metallic-web, workpiece **106**, thereby preserving the integrity of these seams or folds during the forming process. Moreover, by forming each of the rods **102** to include a guide key **108**, the present invention also enables the rollers **104** to be positioned at any location along the longitudinal axis of the rods **102** without incurring significant manufacturing delays or requiring specialized tooling.

[0025] It will be readily appreciated that the segmented pyramid roller **100** may be either manually operated or motor driven without departing from the broader aspects of the present invention. Moreover, another threaded adjustment assembly **118**, shown in Figure 2, may be provided to the upper segmented pinch rod **112** to allow the upper pinch rod **112** to be selectively removed from the pyramid roller **100**.

[0026] Figures 5 and 6 illustrate partially exploded views of the pyramid roller **100**. As shown in Figure 5, the upper and lower rods, **112** and **110** respectively, each include a plurality of rollers **104** spaced along the longitudinal axis of the rods **112** and **110**. The third, radius rod **116**, shown in Figure 6, also includes a plurality of rollers **104** spaced along the longitudinal axis of the rods **116**. Securing apertures **120** may be formed in the rollers **104** to fix the rollers **104** at specified positions along the rods **110**, **112** and **116**. The securing apertures **120** permit the introduction of a threaded pin, bolt or the like which hold the rollers **104** in place once the threaded pin or bolt is tightened against the rods **110**, **112** and **116**.

[0027] As discussed previously in conjunction with Figure 4, the radius rod **116** is selectively movable to elicit varying radii of curvatures to the workpiece **106** as the workpiece travels through the roller **100**. Moreover, as further illustrated in Figure 6, the threaded adjustment assembly **117** is disposed on either distal end of the radius rod **116**, the manipulation of which causes the radius rod **116** to move, at an angle, away from or towards the rods **110** and **112**. It will be readily appreciated that only one threaded adjustment assembly **117**, with an appropriate gear train, may be alternatively provided without departing from the broader aspects of the present invention.

[0028] Figure 7 illustrates a partial cross-sectional view of the roller **100**, in accordance with another embodiment of the present invention. As shown in Figure 7, the lower segmented pinch rod **110** may be selectively adjusted to capture, or grip, the workpiece **106** between the lower segmented pinch roller **110** and the upper segmented pinch rod **112** via operation of the threaded adjustment assembly **114**. Similarly, the radius rod **116** of the roller **100** is likewise displaceable via another threaded adjustment assembly **117** and provides a variable radius of curvature to the workpiece **106**.

[0029] Gearing **122** is also provided so as to transmit the mechanical, or manual, rotation of one of the rods **110**, **112** and **116**, to the other rods with like speed and force. It will be readily appreciated that any of the rods **110**, **112** and **116**, may be the driven rod without departing from the broader aspects of the present invention.

[0030] While a roller **100** having rollers **104** on each of the rods **110**, **112** and **116** has been disclosed, the present invention is not limited in this regard as alternative configurations are also contemplated by the present invention. In particular, the rollers **104** may be mounted onto either the upper or lower pinch rods, **112** and **110** respectively, without departing from the broader aspects of the present invention. With such an embodiment, the rod which does not support one or more of the rollers **104** would be a smooth rod without the guide key **108** formed thereon. Likewise, the radius rod **116** may also be devoid of any

guide key **108** or rollers **104**, in accordance with another embodiment of the present invention.

[0031] It will be readily appreciated that even when not all of the rods **110**, **112** and **116** are equipped with a guide key **108** and a roller **104**, the present invention still provides for conferring a radius of curvature to a workpiece **106** without crushing or otherwise structurally deforming a seam or fold of the workpiece **106**, provided that a roller **104** is positioned on one of the rods **110** and **112** such that the seam or fold of the workpiece **106** is positioned to be longitudinally displaced from the roller **104**. Another embodiment of the present invention involves utilizing rollers **104** of differing diameters on the rods **110**, **112** and **116**, thereby selectively changing the clearance between one or more sets of rollers **104** mounted on the rods **110**, **112** and **116**.

[0032] While the invention has been described with reference to the preferred embodiments, it will be understood by those skilled in the art that various obvious changes may be made, and equivalents may be substituted for elements thereof, without departing from the essential scope of the present invention. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed, but that the invention includes all equivalent embodiments.